May 28, 1982

Mr. Benjamin H. Bakerjian
Vice President
Energy Terminal Services Corporation
P.O. Box 570
Newark, NJ 07101

Dear Mr. Bakerjian:

This concerns your letter to the Director of the Materials Transportation Bureau (MTB), dated January 21, 1982, but not received by us until March 11, 1982. It has been referred to the Office of Pipeline Safety Regulation for response. Two reports addressing vapor dispersion at the planned Energy Terminal Services Corporation (ETSC) LNG facilities at Staten Island accompanied the letter. One, a generalized report by Arthur D. Little, Inc. (ADL), is entitled "Analysis of Vapor Fence Effectiveness in Limiting Dispersion Hazard Zones," August 1981. The other, by the Colorado State University (CSU) entitled "Dispersion of Vapor from LNG Spills at Energy Terminal Services Corporation: Simulation in a Wind Tunnel," November 1981, is a site-specific report on simulation test results from a variety of spill conditions and vapor detention configurations with plant replication scaled at 1:250.

In this letter, you adopt the position that the mathematical model referenced in 49 CFR 193.2059 is not applicable to the ETSC facilities. Acknowledging the need to satisfy Part 193 for spills from new facilities at ETSC, you propose the use of "vapor fences surrounding the entire process area," and request a review of the reports in accordance with §193.2057 (c)(2)(iv); a finding that the method meets the requirements of §193.2059; and a grant of approval by the Director.

Also, we have received your following letter dated April 2, 1982. This letter transmits testimony of Dr. R. N. Meroney before the Federal Energy Regulatory Commission (FERC), which relates to the CSU tests. It is said to address questions raised in section 4I of the Final Supplement to the Environmental Impact Statement prepared by FERC. In this April 2 letter and another dated April 23, 1982, you argue contrary to your original position, that the ETSC proposed facilities meet the requirements for a vapor dispersion exclusion zone under §193.2059. You base this new position on a conclusion that the referenced mathematical model in §193.2059(c), when applied to a 10-minute spill into the proposed impounding system with a vapor fence 16 feet high, results in zero percent vapor concentration at the plant boundary line.

The following responds to your communications. Although you have not requested an interpretation of the vapor dispersion control requirements under §193.2059, it appears that clarification is necessary, and is as follows:

Clarification

Unless the planned ETSC facilities qualify under paragraph (e), a dispersion exclusion zone would be required for the planned facilities under the requirements of §193.2059, "Flammable vapor-gas dispersion protection." In determining this zone, paragraph (c) provides, in part, that dispersion distance must be determined in accordance with given parameters, using the mathematical model set forth in Appendix B of the report "Evaluation of LNG Vapor Control Methods," or using a model for vapor dispersion meeting the requirements of paragraphs (ii) thru (iv) in §193.2057(c)(2), including approval by the Director. The exception under paragraph (e) applies if the Director finds a dispersion zone computed in

accordance with §193.2059(c) would be impractical to provide and the operator's plan for controlling LNG vapor is found acceptable.

The Appendix B mathematical model was developed to predict downwind gas dispersion resulting from an assumed continuous spill of LNG into an impounding system that lasts at least until vapor overflows the dikes. The model was selected for use under §193.2059 because it had the broadest public dissemination, it is relatively simple compared to hydrodynamic models, and had been widely recommended by commenters during the rulemaking proceedings (Docket OPSO-46). Also, it appeared to predict conservative distances in comparison with other available mathematical models, a necessity when considering the uncertainties of model design and testing. Further conservatism is provided because wind turbulence and eddy mixing in the wake of structures, inherent with actual plant conditions, would aid in mixing vapor with air, thereby tending to reduce dispersion distances under an actual continuous flow spill condition.

The Appendix B model was not designed to predict dispersion from finite spills, or spills of a limited duration, where available vapor detention capacities from dikes or fences of an impounding system exceed the volume of vapor generated by the spill. The Appendix B model, itself, illustrates this point, being based on an assumed "vapor overflow" of dikes resulting from vaporization of a spill. Also, the aforementioned ADL report clearly states on page 13 that "The vapor dispersion model described in the Regulations [§193.2059] is, unfortunately, not applicable to the dispersion from a vapor fence retaining a confined vapor volume." In the case of finite spills into excess vapor containment capacity, like the capacity of the planned ETSC impounding system, downwind gas dispersion results from either wind entrainment (scooping) or vapor expansion due to warming, or both, acting on the confined vapor. Notwithstanding the fact that the Appendix B model is not conceptually suitable for predicting this kind of dispersion from finite spills (and this point was discussed in the preamble of the final rule document). §193.2059 requires use of the model as a conservative standard of protection, with the exceptions mentioned above regarding an alternative model or paragraph (e) findings. Such application assuming a continuous spill condition, we believe, would yield dispersion distances in excess of land currently available for a dispersion exclusion zone at the Staten Island site.

We recognize that on its face §193.2059(d) appears to match the Appendix B model with the permissible 10-minute spill design condition. However, such an application in the case of excess containment capacity would not only be illogical but inconsistent with the intent of §193.2059 of protecting against dispersion hazards since it would lead to the incorrect conclusion that a vapor dispersion threat does not exist. In view of the inherent inconsistency in combining the 10-minute design spill with the Appendix B model where excess containment capacity exists, it is far more plausible to interpret §193.2059(c) as requiring the Appendix B model to be applied with an assumed continuous spill condition, and permitting the 10-minute design spill to be used in connection with any modified or alternative mathematical model an operator might develop. This construction of the standard yields a conservative result and is supported by the preamble to the final rule which notes that the Appendix B model is limited to continuous spills (45 FR 9195). Therefore, MTB finds invalid your subsequent contention that by using the Appendix B model to predict dispersion from a 10-minute spill, the planned ETSC facilities meet the requirements of §193.2059.

Alternative model

Under §193.2059(c), if an operator does not compute dispersion distance by the Appendix B model based on an assumed continuous spill from a failed transfer pipe, an alternative vapor dispersion model,

requiring among other things the Director's approval, must be used in determining distance for the dispersion, exclusion zone (unless paragraph (e) applies as discussed above). Provisions for use of an alternative model were included in 193.2059(c) for a variety of reasons: (1) Limitations of the Appendix B model were recognized, in that it did not provide for a finite spill, nor address other factors (e.g., scooping) which might more accurately predict dispersion distance; (2) A number of other predictive mathematical models had been or were being developed; (3) Unified agreement on dispersion phenomena did not exist; (4) Field experimentation used to test any of the models was of limited scale, and data were somewhat questionable; (5) Large scale verification tests were believed to be necessary and were being contemplated; and (6) Commenters during the rulemaking proceeding strongly advocated a final rule that allowed the use of alternative mathematical models.

The intent, then, of providing for the use of alternative models was to permit operators to take advantage of new technical information as it becomes available in developing predictive mathematical dispersion models, generally similar in type to the Appendix B model. However, it is highly unlikely that mathematical models could be conceived to address site-specific dispersion conditions of eddy entrainment in the wake of structures when volumetric vapor detention capacities approach or exceed the volume of vapor from a finite design LNG spill. The uncertainties in regard to development of such a model are confirmed on page 13 of the ADL report. Therefore, since the methodologies used in the CSU report address dispersion due to diffusion from eddy mixing in structure wakes by scale-model wind tunnel tests rather than by a mathematical model, the information you have submitted does not qualify as an application for approval of an alternative model within the meaning of §193.2059(c).

Petition for findings under § 193.2059(e)

A plan for controlling vapor other than by a dispersion exclusion zone (such as automatic planned ignition or other methods that preclude flammable vapor dispersion from the LNG plant site) may be submitted for a finding of acceptability under paragraph (e) and, if found acceptable, qualify the proposed facilities under §193.2059. Paragraph (e) requires, as a precondition to such finding, that the Director also find that it would be impractical to provide an exclusion zone for the proposed facilities in accordance with the requirements of §193.2059.

The proposed vapor fence concept, having retention volumes in excess of vapor volumes from design spills, and use of physical model simulation testing in wind tunnels at 1:250 scale to determine that flammable mixtures will not leave an LNG plant site constitute such a plan for vapor control. Therefore, if ETSC petitions according to §193.2015 for findings of impracticality and acceptability under §193.2059(e) based on the wind tunnel, planned ignition or other vapor control concept, our review will proceed in accordance with paragraph (e) and the procedures of §193.2015. Anticipating receipt of such a petition, we are developing detailed guidelines related to the kinds of information that would be needed for our consideration of the wind tunnel approach in addition to the data you have already submitted.

Sincerely,

Melvin A Judah
Acting Associate Director for
Pipeline Safety Regulation
Materials Transportation Bureau